THE GENDER OF THINGS

How Epistemic and Technological Objects Become Gendered

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INTRODUCTION

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Gendering Things

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Do things have gender? What an unthinkable question especially to space engineers who put astronauts on the moon; to artificial intelligence researchers who construct humanoid robots to assist humanity in saving the planet; to physicists who investigate nature inside a scientific laboratory; to surgeons who struggle to save human lives in state-of-the-art operating theatres. Yet, what seems "unthinkable" to practitioners in science, technology, and medicine, has been common knowledge to scholars working in the humanities and the social sciences: things can be and have been gendered. This is a book about the processes of gendering things. It is an interdisciplinary approach to the power relationship between gender and the material culture of technoscience—in other words, between gender and contradictory cultural, economic, and social values and meanings attributed to epistemic and technological objects.

With the telling subtitle *How Epistemic and Technological Objects Become Gendered*, the book focuses especially on all those things that lie on laboratory benches, engineers' workshops and medical facilities. Things are routinely part of science, technology, and medicine. They range in size and scale from discrete, usually portable objects such as a dummy, wax and string, fans, chromosome images, calibration equipment, cosmetics, autopeds, and robots to network things such as a wall prototype, a virtual personal assistant, and a Scrum board. I envision all those things—already and always embedded in assemblages of epistemic and material systems—as crucial links between the production of knowledge and its producers; between the latter and the consumers (or what we think are simply consumers) of knowledge; between social and epistemic structures and individual gendered actors. Things signify more than gender hierarchies. They become sites where normative discourses are incorporated and, in conjunction with humans,

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they act to devalue manual tasks, impose gender divisions of labour, and construct normative masculinity and femininity. Yet, things are not only the inanimate objects that people act upon—and that in turn act upon people. In this book, the human body constitutes a thing in itself. Box 1, for example, reconstructs the ways nuclear physics transformed the male, white body into a normative, universal one, which facilitated and eventually dominated radiation dosimetry after the Second World War.

In inviting authors to contribute, I admit that I had a vision. I wanted to legitimize the "unthinkable" question—do things have gender?—among science practitioners and engineers. How does a thing such as a spacesuit, a humanoid robot, or a surgical instrument become a gendered object? How does this affect the science produced? By inquiring into the gender of things, the authors in this book collectively question the politics of design in major historical examples but also regarding current, hotly debated issues such as artificial intelligence. Each chapter examines a thing[1] through the analytical lens of gender. Each reveals how the concept of gender has been embedded and finds expression in the material world of science and technology. On the premise that things are inextricably entangled with the conditions of their designing and production, this book emphasizes the gender experience.

Our point of departure is that things are not merely material constructions. What science and technology studies scholars have taught us is that they are best understood as assemblages of people, materialities, practices, and possibilities.[2] Strongly tied to the conditions of their production—social, material, cultural, or epistemological—things also embody several historical layers. This book peels away the variety of historical and cultural layers of things, including human bodies, to expose the historicity of gender. Thus, what this collection additionally reminds us of is that our material creations not only bear knowledge about our world (Baird 2004) but that they are also used to systematically define or resist gender identities. For example, Sophia, the humanoid robot to be named the United Nations Development Programme's first ever Innovation Champion, comes with a gendered notion of how artificial intelligence conceptualizes human–robot interactions (Søraa and Bruijning in this book). The make-up kit exhibited at the Smithsonian National Air and Space Museum and once designed for the first women in space becomes a means for understanding the multiplicity of the gender meanings of things (Armstrong in this book). The first heart transplanted to a human being speaks to the gendering of medical disciplines and the objectification of the female donor (Böhrer and Pfaller in this book). The proposition of a 2,000-mile-long wall at the southern border of the United States exhibits the power of engineering to produce an ontological project of racist and sexist nationalism (Slaton in this book).

What this collection of chapters misses, however, is the voices of the users of epistemic and technological objects. For example, we lack accounts of

women using the autoped in the 1920s (Weber in this book). We cannot hear the voices of all those who had to take a radioiodine uptake test in the mid-1950s (Rentetzi in this book). We even miss the accounts of those who enter their data in genealogical databases (Herzig in this book). Here we are left with multiple interpretations and practices. But we compensate for this with auto-ethnographic and anthropological accounts of encountering, for example, virtual personal assistants (Lamoureaux and Hagerty in this book) and with autobiographical morsels about what it would mean to use a make-up kit in space (Armstrong in this book).

In what follows, the case studies—the things—collected here demonstrate the diverse capacities of objects to act (1) inside a laboratory or even become a laboratory themselves, (2) as artefacts, and (3) as sites of power, network things that structure gendered and racial economies of power.

The trigger: An unfit spacesuit

The Gender of Things was triggered by an event that made headlines in 2019. On March 29, 2019, for the first time ever, an entirely female team of NASA astronauts, Christina Koch and Anne McClain, was supposed to do a spacewalk outside the International Space Station in low earth orbit. "It is a big step for women," *The Washington Post* wrote on March 7 (Epstein 2019). Planned to take place during Women's History Month, the all-female spacewalk was considered a "milestone" by NASA (Dunbar 2019). In the history of five decades of spacewalking, women now had the first opportunity to conduct a spacewalk all by themselves. It was indeed a significant event that added to the agency's efforts to change its gender legacy at a time when NASA was also "look[ing] forward to putting the first woman […] on the moon" with the 2024 lunar exploration (Dunbar 2019).

The response to why it had taken NASA that long to organize an all-female spacewalk was a lesson in the naturalization of gender differences. At a press conference, Ken Bowersox, the acting associate administrator for NASA's division of human exploration and operations, argued that

> There are some physical reasons that make it harder sometimes for women to do spacewalks […]. It's a little bit like playing in the NBA. I'm too short to play in the NBA, and sometimes physical characteristics make a difference in certain activities, and spacewalks are one of those areas where just how your body is built in shape, it makes a difference in how well you can work the suit.
>
> *(qtd. in Koren 2019)*

Nature was called on to justify what was based on social stereotypes and gender preconceptions ever since the Cold War. Gender discrimination in the

US space programme indeed has a long history. Just an indicator. In 1962, Linda Halpern, a schoolgirl fulfilling an assignment, addressed President John F. Kennedy with a simple question: What she would need to do to become an astronaut? "[W]e have no present plans to include women on space flights," NASA responded directly, "because of the degree of scientific and flight training, and the physical characteristics, which are required" (qtd. in Weitekamp 2016). To link women's social positions and their rights to participate in certain technical and scientific fields, to the specificities of their bodies—small, short, weak, fragile, delicate—is to justify the firm dichotomy between a "universal" man and woman and the cultural and social inscriptions of what their bodies can do.

However, as Elizabeth Grosz has asserted "the body is the most peculiar 'thing,' for it is never quite reducible to being merely a thing; nor does it ever quite manage to rise above the status of thing" (1994, xi). It stretches the notion of physicality that dominates the natural sciences, the same notion that has colonized female bodies and constructs their naturalness. NASA's response then (in 1962) and now (in 2019) is surprisingly stable, which is worrisome. As representations and cultural inscriptions construct bodies (see, e.g., Grosz 1994; Scott 1986), they simultaneously reproduce themselves. Women cannot fully enter into the space programme because of their physical characteristics, now as then. At work here is the corporeal issue, that is the objectification of the body and its reduction to a set of anatomical statistics based on a supposedly universal human body. In a historical parallel, the Standard Man [Box 1], configured by the nuclear industry and its regulators in the early 1950s, is an illustrative example of how human bodies are things, albeit peculiar things, "materialities that are uncontainable in physicalist terms alone' (Grosz 1994, xi). Yet, the aim of Cold War physics has been to turn bodies into containable objects; to "fit" the immense diversity of male bodies into a norm and then produce objects that mimic it. If this had enormous consequences to women's bodily experiences, one should not forget the effects of standardization on male bodies as well (Rentetzi 2022).

BOX 1 THE STANDARD MAN: THE BODY AS A THING

Discussing toxic architecture, Maxwell Smith-Holmes argues that "[j]ust as architectural modernism looked at an ideal human figure for a system of social organization, the nuclear age sought its own universal human as a model for life on a toxic planet" (2022). Imaging phantoms simulating the human body or parts of it played that exact role. Right after the Second World War, the International Commission on Radiation Protection (ICRP) recognized the need to formulate a set of standard biological parameters, describing the "average

individual," that could be used to calculate permissible radiation doses for those working with radionuclides. A construct of the atomic age, the "average individual" could then justify the level of radiation exposure that nuclear workers were made to accept (Cram 2016). In 1949, during the Chalk River Conference on Permissible Dose convened in Ontario with the participation of the United States, Britain, and Canada, the ICRP formalized what was going to be considered the "Standard Man," the first statistical baseline of the average human (ICRP 1975, 2).

Interestingly enough, this first standardized anthropomorphic phantom and the figures for the mass of his organs were based on the data collected by female radiologist Mary Jane Cook (ICRP 1975, 2, 6; Bolman 2018). Throughout the 1940s, Cook worked at the Health Physics department of Oak Ridge National Laboratory. Her task was to collect anatomical and physiological data relevant for determining the maximum permissible internal dose of radiation for reactor workers, the vast majority of whom were men. Based on their data, Cook's 1948 "Survey Report of the Characteristics of the Standard Man" became one of the main sources for the ICRP's first reference man for future radiation studies (Bolman 2018). Based on Cook's data, Walter Snyder, the head of the laboratory's dosimetry research group, formulated the first phantom, a 3D model of the human body known as the "MIRD Phantom" (ORNL 2003, 20).

The second source of data for the ICRP's Standard Man came from the Argonne National Laboratory and Hermann Lisco's extensive research on nuclear workers. Lisco was the first physician to perform an autopsy on an employee of the University of Chicago's Metallurgical Laboratory, part of the Manhattan Project, who died of radiation poisoning in 1945.[3] From 1947 to 1952, he directed Argonne's Medical Division where he built on his war experience working on plutonium. As he acknowledged in 1949, the major problem at the time was the determination of permissible dose levels. He noted that

> this applies of course to both external and internal irradiation and it is an especially important matter with respect to radioactive isotopes introduced into the human body either intentionally (therapy, tracer-studies) or accidentally. […] It appears essential, therefore, that certain standard figures be adopted as "norms" for the various components of the human body in order to make calculations by various investigators meaningful and comparable.
>
> *(Lisco 1949, 96)*

Already in 1945, a "Standard Man" had been in use but only in 1947 complete norms were adopted. Lisco was clear about the effectiveness of the human standard: "It is obvious that these [data] cannot be considered anything but good approximations" (1949, 96). Indeed, what was presented as the

"average" and the result of objectively collected statistical data was in fact highly gendered and scientifically inaccurate. The Standard or Reference Man was white, male, weighed 70 kg, and was between 20 and 30 years old (Lisco 1949, 97). "Though the gendering of 'Standard Man' could appear to be a relatively trivial oversight," historian of science Brad Bolman claims, "it is worth noting that these figures determined radioactive safety standards around the world for decades to come" (2018).

In 1963 the ICRP changed the name from "Standard Man" to "Reference Man" to account for "the increased emphasis on exposure of the population" (ICRP 1975, 2–3). The ICRP's Task Group that prepared the standard and reviewed the data accepted that "it was not feasible to define Reference Man as an 'average' or a 'median' individual of a specified population group" (4). The shift from "standard" (and thus universal) to "reference" (and thus exemplary) reflected the growth in public anxiety over nuclear weapons testing. But despite the linguistic shift, gender assumptions about the "normal," the "standard," and the "average" were still at play, as the norm continued to be the "typical occupational individual," "a typical individual of the European or American populations," "a Caucasian"—i.e., the young, healthy white male (3–4). The Reference Man was still defined by the exact same proportions as the standard one, and it still set the same gendered standards to be used in radiation dosimetry.

Throughout the 1950s and 1960s, this set of anatomical statistics, the Standard Man, was translated into a supposedly universal model of the human body. Several US laboratories constructed their own phantoms based on the ICRP's recommendations and the studies that preceded them. Thus, gendering the Standard Man was not trivial at all. The exemplar of the human body was one of the most important manifestations of power and consequently gender relations in the nuclear age. Generations of radiation scientists shared a certain material and epistemic standard in their dosimetry studies, a standard that was inextricably linked to not only gender but also racial, ethnical, and colonial biases that the Standard Man represented.

Designing artefacts such as spacesuits based on the universal and the standard, reinforces the importance of physicality and justifies exclusion. It prescribes femininity as much as it does masculinity, both in the singular. In return, it vindicates how and why one genders certain artefacts and how and why—based on these attributions of gender—one grants or restricts access to science and technology.

Think of the women astronomers working at the Harvard College Observatory in late nineteenth century, meticulously studying photographs

and analysing star charts (Mack 1990); the women who routinely counted scintillations in a dark room in Vienna's Institute for Radium Research in the early twentieth century (Rentetzi 2007); the women who worked as "human computers" performing ballistic computations (Light 1999); the female chemists hired by the British industry to perform routine work due to their "manual dexterity, their delicacy of touch, their conscientiousness and their willingness to bear with a routine under which most men become impatient" (Horrocks 2000, 352); the female operators of the Franckenstein track-measuring reading machines throughout the Cold War. A read off and calculation apparatus that reduced bubble chamber film to machine-readable data, the "Franckenstein" measuring machine marked a shift in gender roles within the physicists' workplace in the late 1950s: "unskilled" women took up the "natural" role of scanning photographs and recording data, whereas male physicists interpreted the results (Galison 1997, 374–76). Think of the ways tedious routine or mundane work in general has been labelled as "naturally" a women's task. Think, eventually, of the power of materiality, the power of defining gender based on its physicality, the power of "things" including bodies as they have been inscribed gender status. Having predefined what a body can do, when time comes to define who is likely to fit a routine job, gender segregation easily comes at play (as does segregation based on race, ethnicity, and much more).

Back to NASA. Despite the high stakes, on March 25, the agency unexpectedly announced that the all-female spacewalk had to be cancelled. "What should have been a giant leap for womankind has turned into a stumble" noted *The Guardian* (Cantor 2019). As a NASA spokeswoman, Stephanie Schierholz, explained, "Anne [McClain] trained in 'M' and 'L' and thought she could use a large but decided after Friday's spacewalk a medium fits better." Schierholz was referring to the size of McClain's spacesuit. Both female astronauts needed size M but NASA did not have two spacesuits in that size readily available. Thus, "[o]ne of the two women on the mission" had to "give up her place to a male colleague." Despite the bad publicity that could (and did) follow, that is, McClain refused to use an L suit (Cantor 2019; see also Fortin and Zraick 2019).

The need for different sizes was not news to NASA. A year earlier, in 2018, the agency had recognized that "No difference exists in a male's or female's suit, though the female astronaut usually requires a smaller size" (NASA 2018). The aborted all-female spacewalk, as expected, made headlines in all major newspapers and outlets. "Make another suit," Hillary Clinton immediately tweeted[4]—and embarrassed the Trump administration internationally. The space race was the ultimate symbol of the Cold War technological competition between the United States and the Soviet Union. Recall how the launch of the Soviet Union's first artificial satellite Sputnik 1 in 1957 marked the Soviet victory in the space race while it exercised an

immense pressure on US leaders.[5] At stake was more than technological and scientific superiority. Geopolitics was then, as it is now, the issue. And in 2018, women's spacesuits got caught up in this issue.

The 2019 story of NASA's spacesuits is not about the "thing" itself. The spacesuit becomes the entry point to recall and understand the legacy of sexism in the space program (for this, see Weitekamp 2004). Historically, space equipment, including spacesuits, was designed with men's physique in mind. Male bias is already embodied in the design of the spacesuit as such. But this is far from surprising. A knife in a surgeon's hand provides an indication of how medical ergonomics, too, favours males: given that until recently men tended to be the majority in the field, surgical instruments were always designed to fit male surgeons (Hopkins n.d.). The recent COVID-19 pandemic revealed the ways that medical instruments—such as the pulse oximeter, which turned out to be crucial in identifying early Covid pneumonia (Levitan 2020), or an "artificial-intelligence system used to analyse chest x-rays and identify 14 different lung and chest diseases" (Wallis 2021; see also Kadambi 2021)—proved to work less well for women. Computational biases and data based on homogeneous white, male groups were identified as the source of such insufficiencies. In Vilém Flusser's terms (1999), our future depends on the design of things.

When it comes to military technologies, Rachel Weber (1999) argues that women have been excluded by design. As cockpits were designed based on men's bodily specifications, women, being usually shorter, with less upper body strength and smaller limbs, found it difficult to accommodate. "[I]f women cannot 'fit' into the JPATS [Joint Primary Aircraft Training System] cockpit or if the cockpit does not 'fit' women pilots, they will be unable to pursue aviation careers in the Navy or Airforce," Weber summarized (375). If one also takes into account the fact that women have been underrepresented as technology designers, it becomes obvious why exclusion by design is so ubiquitous in both science and technology. Objects such as spacesuits are highly technological things, "masterful feats of engineering" (Grush 2019). Speaking from experience, Daniel Burbank, a former astronaut and senior technical fellow at Collins Aerospace, explains that "A spacesuit has to basically have all the functionality of a spacecraft with as little excess volume as possible, so the crew member can operate within the suit" (qtd. in Grush 2019). Thus, to wear an 'M' size and not an 'L' is vital. To paraphrase Weber, if women cannot fit into a spacesuit or the spacesuit does not fit women astronauts, they will be unable to pursue careers in NASA. The argument has been corroborated both historically and by recent instance.

On June 1, 2022 a NASA press release announced that Axiom Space and Collins Aerospace had been contracted for "services that provide astronauts with next-generation spacesuit and spacewalk systems to work outside the International Space Station, explore the lunar surface on Artemis missions,

and prepare for human missions to Mars" (NASA 2022). Partnering with industry, the agency plans to meet the gender and diversity challenge on the moon, designing spacesuits that will take into account bodies—male and female—that do not fit the existing norm (Grush 2022). From 2019 to 2022 and from the embarrassing arguments about female physiques to the discourse about inclusive spacesuits, NASA has indeed gone a long way. The agency's massive space ambitions coupled with the outraged international reaction resulted in a fundamental change in perspective. The shift from exclusion to inclusion by design and from the universal anthropometric norm to the subversion of the male standard promises to result in a less gendered space programme as a whole (Kowal 2019).

A selection of things

To philosopher Hannah Arendt, things "constitute the condition under which […] human life can be at home on earth" (1958, 134). But if things are so crucial to selfhood and humanness, why do we neglect to question their gender? If we especially focus on technoscientific things, objects that fill our science labs and engineering workshops and overcrowd our everyday lives, it is reasonable to assume that those could be equally gendered. If true, this undermines a basic scientific tenet: the neutral position of the observing and knowing subject, whose bodily constitution and experience play hardly any role in the epistemic process, especially in the physical sciences. The approach of the chapters in this book is to unravel what Jane Bennett has termed "thing-power," i.e., "the curious ability of inanimate things to animate, to act, to produce effects dramatic and subtle" (2010, 6), effects on masculinities and femininities. The endless practices of shaping and tinkering, designing and staging a variety of things take centre stage here. The book offers an array of cases that portray the diverse capacities of things to perform gender.

Things in/as laboratories

The laboratory as a prominent site of knowledge production, the exemplary site of modernity, has been at the centre of history of science and science and technology studies (STS) analyses since the mid-1970s.[6] Here we will revisit the space of the laboratory to closely examine things that have been routinely used as epistemic tools, to such an extent that they become overly familiar and thus invisible in the process of producing knowledge.[7] In the book's first chapter, Donald Opitz focuses on one of the most trivial, mundane, and dismissed laboratory tools—sealing wax and string—and explores its gendering. In the late nineteenth century, sealing wax and string symbolized the modesty of a laboratory, thrifty science before twentieth-century big data and devises, the proudness of an older generation of scientists who struggled

to survive changes in the material culture of their fields. Although these tools were very prominent and handy at Cambridge's Cavendish Laboratory—for example, in observations on water jet streams, in creating vacuum seals at glassware joints, or in transmitting static electricity between conductors—they remained largely unnoticed by historians of science. In addition to pointing out the importance of sealing wax and string to nineteenth-century physics, Opitz reveals how it preserved the discipline's masculine tradition. Originally a domestic technique serving the needs of paper communication in the early nineteenth century, using wax for sealing emigrated to the laboratory with the emergence of experimental science. This shift—as many others during this period of high professionalization in the sciences—left women's skills in sealing letters with wax unused and dismissed in the world of science. In the male-dominated site of the Cavendish Laboratory, fabricating sealing wax and string for scientific use also meant fabricating women's position as unfit for laboratory work.

At the intersection of science and art, Anna Frasca-Rath introduces butter as a thing that lies both in the family's kitchen, a prominent site for producing knowledge in the early modern period,[8] and the art studio. Produced in domestic spaces, butter was a material that women artists not only had access to but also knew how to make and preserve. At a time when women sculptors were often forced to prove that they had executed their sculptures themselves, materials played a key role in artistic production. Being soft, butter matched assumptions about women's delicate nature and weakness, and thus was considered a "natural" material to be artistically manipulated by them. In a similar way to the production of wax, the gender division of labour concerning the production of butter determined who was able to practice art and who was not. When during the nineteenth century butter-making left the domestic space and moved to industrial sites—following technological innovations in agriculture, the dairy industry, and food freezing—the making of sculptures out of fat became a male reserve. The materiality of the "thing" and its production—domestically or industrially—thus reinforce assumptions about manual skills and women's "natural" abilities.

María Jesús Santesmases analyses images of chromosomes and examines how the naturalization of these images resulted in excluding women from the field of cytogenetics from the mid-1950s onward. A manual skill, that of producing chromosomal images, is again at the centre here. The experimental process of locating and photographically capturing chromosomes during cell division was highly delicate and complex. It required experimental experience, technical ingenuity, and dexterity. Lore Zech, née Vogt-Köhne, a scientist trained in biology, physics, and chemistry in the early twentieth century is Santesmases's key actor. Zech's contributions to devising the chromosome banding technique, which allowed the recognition of individual chromosomes and thus the production of chromosomal images, played a

vital role in providing cytogenetics with the notion of constituting a scientific community with powerful tools and theories. Santesmases traces the lineage of a number of women who contributed to the establishment of image making in the biological sciences as a strong epistemic practice that produced the visual cultures of heredity and genetics. Yet, labelling the production of chromosomal images as a manual skill—so crucial to the visual and material epistemology of cytogenetics—meant also labelling the women scientists who produced these images as mere technicians, and thus as being at the bottom of the hierarchy within the laboratory sciences.

My own contribution is centred on a "thing" that mimicked the human body to model radiation doses. Françoise, a phantom of a female torso with perky breasts, allowed for the calibration and standardization of a medical test involving a radioactive isotope, an endeavour of high political significance during the early Cold War. The set of anatomical statistics that stood for the human bodily norm, the average patient, had its source in real bodies which, for different reasons, had been exposed to radiation. Besides being a thing inside the laboratory, then, Françoise was the result of the human body becoming a laboratory itself, an experimental site of the nuclear age. She was constructed in 1961 by male engineers and technicians at the laboratory of the International Atomic Energy Agency (IAEA), following the recommendations of an all-male expert group. A replica of a series of female phantoms with wigs and red lips produced in the mid-1950s at the Oak Ridge National Laboratory, Françoise was a highly gendered thing in a highly male-dominated space. From spring 1962 to the end of 1965, "she" travelled in a box-like suitcase that included a number of mock iodine standards. Her companion was Godofredo Gómez Crespo, a Spanish physicist who was employed by the IAEA to conduct the calibration and standardization project on a global scale. The trip highlights the masculine culture of physics and the way this was maintained and diffused to laboratories on a global scale.

Annerose Böhrer and Larissa Pfaller take one step further the idea of the human body as a thing by focusing on a bodily part: a heart. Their story is centred around the first heart successfully transplanted to a recipient in 1967. The transplant took place without the female donor's consent, and the male recipient lived only for 18 days after the history-making transplantation conducted, needless to say, by a male surgeon. The authors follow the heart from Denise Darvall's dead body to a jar at Cape Town's former operating theatres, which were since turned into a museum, where it is now exhibited. They follow the heart as it disappears, together with its female donor, behind its multiple ontologies as bodily part, medical object, and museum artefact. The point here is not just the medicalization of the female body, the triumph of the male doctor in a medical profession in which women were underrepresented, and the gender-biased ways that the story made headlines.

Böhrer and Pfaller expose the body as a thing by considering how the process of organ donation displaced the representation of a transplanted female heart into the male-dominated surgical profession.

The attention to how the human body becomes objectified resurfaces in Milton Fernando Gonzalez Rodriguez' contribution on cosmeceuticals as gendered everyday objects that reflect non-everyday epistemic systems and (traditional) knowledge transfers. His argument is that cosmeceuticals, and especially antiaging cosmetics, are epistemic objects that transform care practices into colourful "mini-laboratory" experiments where human skin is subject to trial and error. After all, the female skin becomes an "unsupervised minilab" to satisfy ideals and gendered standards of physical appearance.

Things as artefacts

For long, the history of technology has focused on artefacts as technical entities and scrutinized the role of inventors, engineers, scientists, corporations, the state, regulators, the press, and of course users and consumers. Scholars such as Wiebe Bijker and Trevor Pinch explored the role of negotiations and struggles in the process of establishing new technologies and inventing artefacts. The notion of a social group as the definitive collective actor in the evolution and stabilization of technical things has been central in the scholarly tradition they established in the mid-1980s (Pinch and Bijker 1984). And historians of technology such as Ruth Schwartz Cowan (1976) made clear already in the 1970s that technology was largely a male province.

Based on this tradition, Heike Weber emphasizes the design and use of the *Autoped*—literally the self-propelling feet—as a gendered artefact targeted at women in the early twentieth century. Her entry point is a photograph of the British suffragette Lady Florence Norman in an empty London street, standing on a scooter produced by the New York-based autoped company. The artefact, a 1918 *Autoped*, is part of the Smithsonian's National Museum of American History collection. As Weber argues, when certain female user groups appropriated such "male" mobility technologies for their needs, these user practices were not only read as signs of emancipation, but they also enforced the gendering of technologies for individual transport.

Another item at the Smithsonian, this time at the National Air and Space Museum, is Ellie Armstrong's "thing" of analysis. The make-up kit (item no. A20020252000), a little yellow cosmetics case featured in the museum, was designed for the first American women astronauts. To Armstrong, the kit's normative gendering, in a space shuttle as much as in a museum's display cabinet, deserves critical inquiry. Based on Sara Ahmed's notion of queer use, that is the "improper use of something" (2018), she explores the queering of gender through the NASA's make-up kit.

However trivial or mundane artefacts may be, they intentionally signal that they are tools, material entities modified in such a way as to enhance their efficacy. Annette Keilhauer's chapter introduces us to an ordinary artefact that we are accustomed to seeing in a mother's boudoir and in the hands of elderly women. Coming from Greece, to me the fan signifies the leisure of hot summers, reminding me of my upbringing by the sea. Keilhauer undermines the naivety of childhood memories and brings forward the powerful meanings of the fan. Focusing on France in particular, she offers a cultural history of the fan, its functional and symbolic potentials, and sketches the ways it has been entangled with women's emancipation and gender stereotypes. In our own time, she observes, the fan has had a revival in the context of paramedical advice on how to deal with menopause hot flashes. From a gendered fashion and political artefact, then, the fan has gone to claim its place in medical history.

The last two chapters in this section proceed from the assumption that things are networks, often complex and difficult to decipher. Roger Søraa and Nienke Bruijning take us to a different genre of artefacts, multifaceted, far from mundane, and technologically demanding. The focus is on Sophia, a humanoid robot that was designed by a Hong Kong-based company in 2016. Through wide press coverage and a celebrated visit to the United Nations headquarters, Sophia entered social and political life on a global level. Responding to the central question of this collection, Søraa and Bruijning analyse Sophia as a gendered artefact and discuss how gender is performed and constructed through the robot's appearance(s). Having multiple identities—a UN ambassador, a robot, a model, a (supposed) proof of the promising future of artificial intelligence—Sophia is not simply a technical construct. She is an artefact, a socio-technical entity that communicates multiple gender meanings.

Siri Lamoureaux and Alexa Hagerty explore the gendering of Siri and Alexa, Apple's and Amazon's intelligent personal assistants (IPAs). When I first received their abstract, I was persuaded that this was an ingenious hoax. The first names of the authors match the artefacts they analyse—a once in a life-time coincidence! Through an auto-ethnographic study that reflects on that coincidence, Lamoureaux and Hagerty remind us that semantics indeed are powerful. By giving IPAs women's names and other feminized attributes, computer engineers eventually dehumanize women in addition to gendering machines.

Things as sites of power

In *The Order of Things* (1966), Michel Foucault argued that "things themselves hide and manifest their own enigma like a language" (1970, 35). In the scholarly tradition inspired by Foucault's work, things are crucial

material tools in the ongoing process of power being exercised as for the purpose of social and self-governance. Amy Slaton's "thing," the design of a 2,000-mile-long wall at the southern border of the United States, a wall on paper and a combination of steel and concrete prototypes, is literally and figuratively a site of power. During the Trump administration, the wall was portrayed as a means of excluding purportedly dangerous individuals from Mexico, reproducing and enforcing racist and gender stereotypes about both Latino men and (white) American women. To Slaton, the engineering labour associated with this structure represents an ontological project of racist and sexist nationalism: the materiality of the wall signified the threatening, athletic and sexually inflamed male persons of non-white, non-US identity; as well as the physically weak, passive, and desirable white female Americans in need of protection.

Rebecca Herzig draws our attention to another engineering project, the genealogical databases used to display links between scientific researchers according to mentoring and training relationships in academia. I read this chapter as an attempt to unravel the power of things "to animate, to act, to produce effects dramatic and subtle" (Bennett 2010, 6), effects on both masculinities and femininities. By representing networks of academic researchers as familial lineages, the genealogical database reproduces gendered asymmetries in scientific participation. A seemingly innocent artefact that facilitates academic life by connecting, for example, dissertation advisors to their advisees, proves to be a powerful thing that maintains gender orders and standardizes gendered academic policies.

Focusing as well on the academic workplace, for the last chapter of this collection Stefan Sauer and Amelie Tihlarik have chosen the Scrum board as the thing for analysis. A visual way to manage and organize projects, the Scrum board is a network thing that enables the collaboration between different actors/partners in a project. Based on Agile, a project management methodology that prioritizes teamwork and small well-defined steps in managerial processes instead of hierarchical structures, the Scrum board is the result of software development with a view to the future of management, demanding a flexible, real-world course of action. Finishing this collection on an optimistic note, Sauer and Tihlarik's chapter allows us to think that the Scrum board has the potential to be regarded as a feminine tool in the male-dominated field of software development.

100 things: Any gendered ones?

Just before I concluded this introduction, I was fortunate to come across the 2018 German-produced movie *100 Dinge* (*100 Things*) (Fitz 2018). The script offers powerful insights into things—trivial everyday things—and their power over human lives. Two best friends, a creative app designer and a

businessman quarrel over the production and marketing of an app and make a bet: they decide to get rid of all of their belongings for 100 days and take back just one item every day. The one who is willing to last longer without his material possessions wins. On the next day, they wake up naked in their empty apartments. Their challenge consists in deciding how to prioritize things: a pullover to protect them from cold weather or a sleeping bag; a pair of pants or a pair of glasses; a mattress or a mobile phone. The question that prevails throughout the movie is why people are unhappy despite the fact that they possess everything they want? Why are things never enough? A witty comedy about materialism and the truly important things in life, and one of the best German movies I have seen, *100 Dinge* helped me reiterate my original, simple question. If things are so closely linked to the human way of life, if they determine it and are the result and cause of human action and thought, why do we rarely question the relation of things to gender, a fundamental human condition? Take *The Gender of Things* as the first, modest attempt at an answer.

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Notes

1 Here the concept of "thing" is used interchangeably with that of "object." For a detailed analysis of the nuances between the terms, see Woodward (2007, 15–16).
2 For a recent short overview of the material turn in science and technology studies and the ways STS scholars have dealt with materiality, see Rentetzi and Ito (2021). Some of the most influential perspectives on the notions of things and objects include, for example, Latour (1996) and Daston (1998).
3 An extensive biographical note on Hermann Lisco can be found on the Harvard Library's Hermann Lisco papers website: https://hollisarchives.lib.harvard.edu/repositories/14/resources/7645
4 https://twitter.com/hillaryclinton/status/1110576558815801345
5 The 2016 US film *Hidden Figures* narrates the story of African American female mathematicians who worked at NASA during the Space Race, and at the same time provides a wonderful glimpse into the tensions, both political and gender, that surrounded the efforts to beat the Soviets. The trailer may be watched here: www.youtube.com/watch?v=5wfrDhgUMGI
6 See, for example, Galison and Jones (1999); Gieryn (2008); Gooday (2008); Hannaway (1986); Hill (1975); James (1989); Latour and Woolgar (1979); Latour (1983); Shapin (1988); and Smith (2006).
7 I have elsewhere developed the notion of the epistemology of the familiar, as an attempt to unravel the epistemic consequences of ordinary, mundane objects (see Rentetzi 2020, 2022).

8 On science and domesticity, see, for instance, Opitz, Bergwik, and Van Tiggelen (2016) and Von Oertzen, Rentetzi, and Watkins (2013).

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